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10/529,851	03/31/2005	Katsumi Suemitsu	8022-1094	1541

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ARLINGTON, VA 22202

EXAMINER

VALENTINE, JAMI M

ART UNIT	PAPER NUMBER
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2809

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	02/12/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

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Office Action Summary

Application No.

10/529,851

Applicant(s)

SUEMITSU ET AL.

Examiner

Jami M. Valentine, Ph.D.

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 31 March 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-20 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 31 March 2005 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date 3/31/05.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____.

DETAILED ACTION

Status of the Application

1. **Claims 1-20** are pending in this application.

US National Phase of PCT

2. Acknowledgment is made that this application is the US national phase of international application PCT/JP03/11956 filed 19 September 2003 which designated the U.S. and claims benefit of JP 2002-290448, filed 2 October 2002.

Foreign Priority

3. Acknowledgment is made that the certified copy of the foreign priority document has been received in the national stage application from the International Bureau:

Drawings

4. There are no objections or rejections to the drawings.

Specification

5. The abstract of the disclosure is objected to because it has too many words. The abstract must contain 50 –150 words. Correction is required. See MPEP § 608.01(b).
6. The disclosure is objected to because of the following informalities: Page 1, line 15 of the specification misspells MRAM. Appropriate correction is required.
7. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

Claim Rejections - 35 USC § 112

8. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

9. **Claim 18** is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

10. **Claim 18**, recites the limitation "said physical and chemical etching". Claim 18 depends on claims 12 and 16, however, neither of these claims recites physical and chemical etching. Hence, there is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 102

11. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

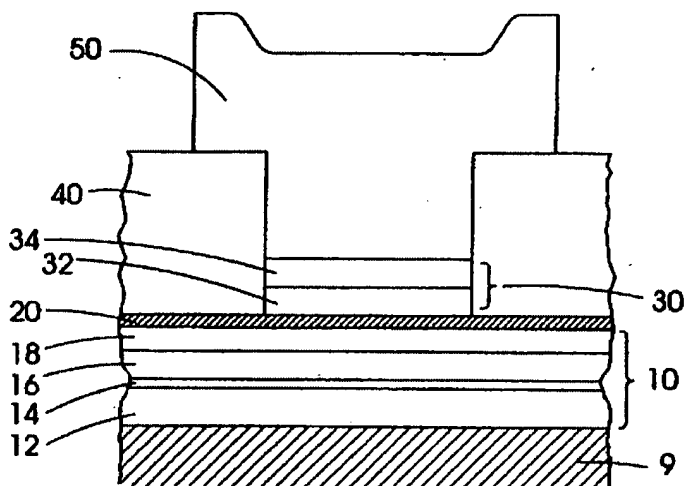
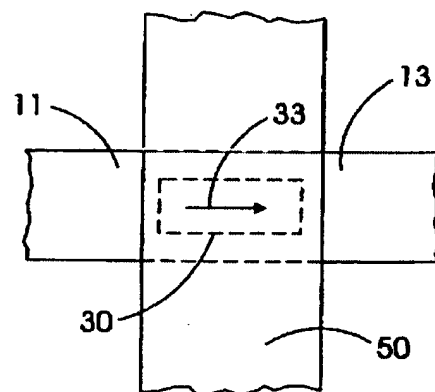
12. **Claims 1- 6 and 11-16** are rejected under 35 U.S.C. 102(b) as being anticipated by Gallagher et al. (US Patent No 5,650,958) hereinafter referred to as Gallagher.

13. Per **Claim 1** Gallagher (figure 4A below) discloses a magnetic memory device, including

- a substrate; (9)
- a lower portion structure provided on or above said substrate as a portion of a magnetic element; (including (12) (14) and (16))

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- an upper portion structure provided on said lower portion structure of said magnetic element; (including (30))
- a sidewall insulating film provided to surround said upper portion structure of said magnetic element (40)

**FIG. 4A****FIG. 4B**

Prior Art: Gallagher Figure 4A-B teaching an MRAM device.

14. Per **Claim 2** Gallagher (figure 4A above) discloses the device of claim 1, including where said magnetic element has a size of an outer circumference of said sidewall insulating film. (see figure 4B)

15. Per **Claim 3** Gallagher (figure 4D below) discloses the device of claim 1, including where said lower portion structure (10') of said magnetic element comprises: a conductive portion (12') and a first magnetic film (14') provided on or above said conductive portion, and said upper portion structure of said magnetic element comprises: an insulating film; (20') a second magnetic film provided on said insulating film (32')

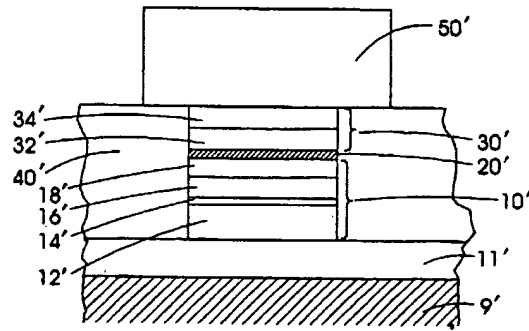


FIG. 4D

Prior Art: Gallagher Figure 4D teaching an MRAM device.

16. Per **Claim 4** Gallagher (figure 4D above) discloses the device of claim 1, including where said lower portion structure of said magnetic element comprises a conductive portion (12') and said upper portion structure of said magnetic element comprises: a first magnetic film (18) an insulating film (20) formed on or above said first magnetic film and a second magnetic film (32) provided on or above said insulating film.

17. Per **Claim 5** in so far as definite, the claims are rejected over prior art as follows:

Gallagher (figure 4A above) discloses the device of claim 1, including where the upper portion structure of said magnetic element further comprises: a conductive film (34) formed on said second magnetic film (32). (column 5 lines 1-3)

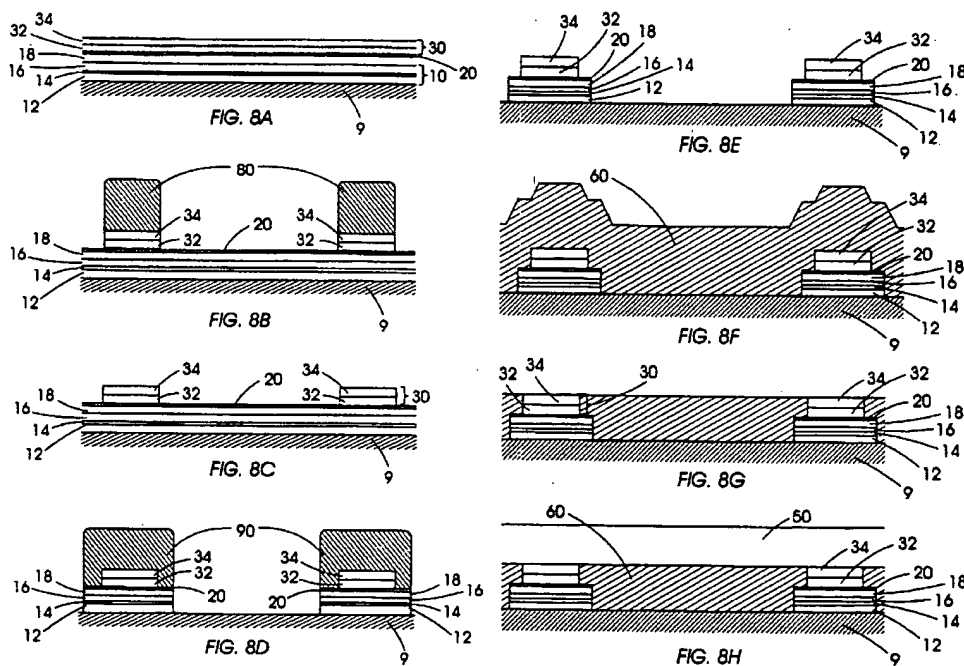
18. Per **Claim 6** Gallagher (figure 4B above) discloses the device of claim 1, including where a plane shape of said upper portion structure of said magnetic element is a rectangle. (column 11 lines 65-67)

19. Per **Claim 11** Gallagher (figure 4A above) discloses the device of claim 1, including where said sidewall insulating film (40) comprises at least one of silicon oxide, silicon nitride, aluminum oxide, and aluminum nitride. (column 5 lines 8-9)

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20. Per **Claim 12** Gallagher (figures 8A-H below) discloses method of manufacturing a magnetic memory device, including

- forming a multi-layer film included in a magnetic element on or above a substrate; (column 9 lines 34-36)
- etching said multi-layer film into a predetermined pattern up to a predetermined depth, to form an upper portion structure of said magnetic element; (column 10 lines 1-14)
- forming a sidewall insulating film to surround said upper portion structure of said magnetic element; (column 10 lines 31-33)
- etching a remaining portion of the multi-layer film by using the sidewall insulating film and said upper portion structure of said magnetic element as a mask to form a lower portion structure of the magnetic element. (column 10 lines 23-26)



Prior Art: Gallagher Figure 8A-H teaching an MRAM device.

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21. Per **Claim 13** Gallagher (figure 4B above) discloses the device of claim 12, including where forming a multi-layer comprises:

- forming a conductive film (12) and a first magnetic layer (14) formed on or above said conductive film in a portion corresponding to said lower portion structure of said magnetic element;
- forming an insulating layer (20) and a second magnetic layer (32) formed on or above said insulating layer in a portion corresponding to said upper portion structure of said magnetic element.

22. Per **Claim 14** Gallagher (figure 4B above) discloses the device of claim 12, including where said etching said multi-layer film into a predetermined pattern, comprises: etching said multi-layer film into said predetermined pattern by using a physical etching. (Ar⁺ ion milling, column 10 lines 1-14)

23. Per **Claim 15** Gallagher (figure 4B above) discloses the device of claim 14, including where said physical etching is ion milling. (Ar⁺ ion milling, column 10 lines 1-14)

24. Per **Claim 16** Gallagher (figure 4B above) discloses the device of claim 12, including where forming a multi-layer comprises:

- forming a conductive film (12) in a portion corresponding to said lower portion structure of said magnetic element; and
- forming a first magnetic layer (18) an insulating layer (20) formed on or above said first magnetic layer; and a second magnetic layer (32) formed on or above said insulating layer in a portion corresponding to said upper portion structure of said magnetic element.

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25. **Claims 1, 8, 9 and 11** are rejected under 35 U.S.C. 102(b) as being anticipated by Tuttle et al. (US Patent No 6,417,561) hereinafter referred to as Tuttle.

26. Per **Claim 1** Tuttle (figure 6B, below) discloses a magnetic memory device, including

- a substrate; (column 4 line 76)
- a lower portion structure provided on or above said substrate as a portion of a magnetic element; (10)
- an upper portion structure provided on said lower portion structure of said magnetic element; (24)
- a sidewall insulating film provided to surround said upper portion structure of said magnetic element (26)

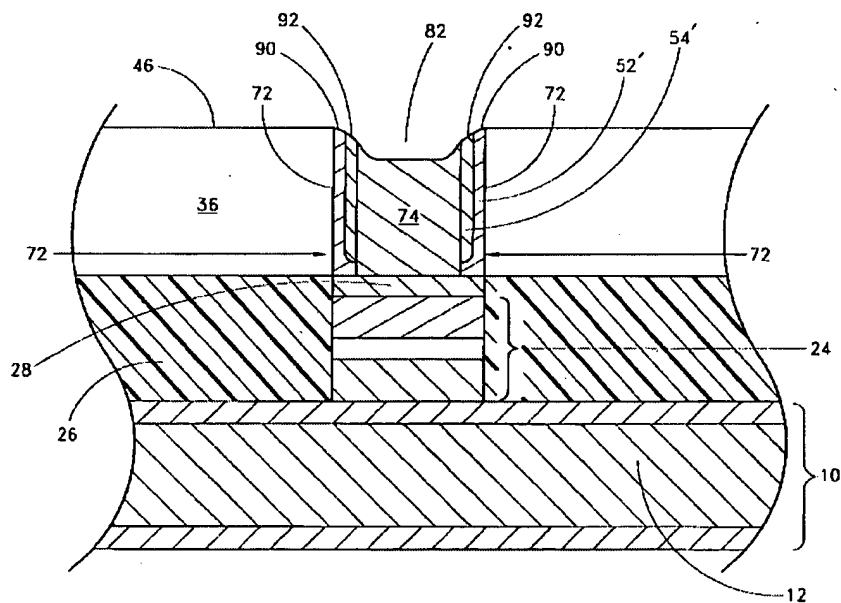


FIG. 6B

Prior Art: Tuttle Figure 6B teaching an MRAM device.

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27. Per **Claim 8** Tuttle (figure 6B, above) discloses the magnetic memory device of claim 1, including where an interlayer insulating film (36) formed to cover the upper and lower portions of said magnetic element, and the sidewall insulating film; said interlayer insulating film having a via-contact (74) connected with said upper portion structure of said magnetic element, and said sidewall insulating film is formed of a material which has an etching selection ratio smaller than said interlayer insulating film. ((26) is a form of silicon oxide or silicon nitride and (36) is silicon oxide (column 5 lines 55-62)).

28. Per **Claim 9** Tuttle (figure 6B, above) discloses the magnetic memory device of claim 1, including where an interlayer insulating film (36) formed to cover the upper and lower portion structure of said magnetic element and the sidewall insulating film; and said sidewall insulating film is formed of a material which has a selection ratio in a chemical mechanical polishing or an etching-back smaller than said interlayer insulating film. ((26) is a form of silicon oxide or silicon nitride and (36) is silicon oxide (column 5 lines 55-62)).

29. Per **Claim 11** Tuttle (figure 6B, above) discloses the device of claim 1, including where said sidewall insulating film (26) comprises either silicon oxide or silicon nitride,. (column 5 lines 55-62)

Claim Rejections - 35 USC § 103

30. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

31. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

32. **Claim 7** is rejected under 35 U.S.C. 103(a) as being unpatentable over Gallagher in view of Bhattacharyya et al. (US Patent No 6,297,983).

33. Per **Claim 7**, Gallagher discloses the magnetic memory device of claim 1 including and upper and lower portions on a magnetic element.

34. Gallagher does not disclose where a distance d on a plane between an the outer circumference the top of the lower portion structure and an outer circumference of an top of the upper portion structure of said magnetic element has a relation of $0.01 \mu\text{m} \leq d \leq 0.2 \mu\text{m}$

35. Bhattacharyya teaches a magnetic memory device with an upper and lower portion including where a distance c on a plane between an the outer circumference the top of the lower portion structure and an outer circumference of an top of the upper portion structure of said magnetic element has a relation of $0.01 \mu\text{m} \leq d \leq 0.5 \mu\text{m}$. (see figure 6D below, and column 3 lines 62-65)

36. It would have been obvious for one having ordinary skill in the art at the time the invention was made to form the magnetic memory device such that the difference, d , in the outer diamters of the upper and lower portions of the device have the relation $0.01 \mu\text{m} \leq d \leq 0.5 \mu\text{m}$ as

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taught by Bhattacharyya for the device of Gallagher, in order to minimize the demagnetizing effects of the emanating from the edges of the magnetic layers in the device. (column 2 lines 61-63)

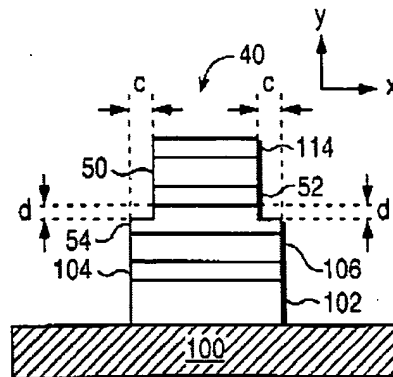


FIG. 6D

Prior Art: Bhattacharyya Figure 6B teaching an MRAM device.

37. **Claim 10** is rejected under 35 U.S.C. 103(a) as being unpatentable over Gallagher in view of Durlam et al. (US Patent No 6,153,443).

38. Per **Claim 10**, Gallagher discloses the magnetic memory device of claim 1 including a sidewall insulating film.

39. Gallagher does not disclose where said sidewall insulating film is formed of at least one of metal nitride, metal oxide, and metal carbide

40. Durlam a magnetic memory device with a sidewall insulating film formed of a metal nitride. (column 4 lines 26-28)

41. It would have been obvious for one having ordinary skill in the art at the time the invention was made to form the sidewall insulating film of a metal nitride as taught by Durlam

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for the device of Gallagher in order to facilitate subsequent etching, patterning or fabrication steps.

42. **Claim 17-18** are rejected under 35 U.S.C. 103(a) as being unpatentable over Gallagher in view of Yoshida et al. (US Patent No 4,566,941).

43. Per **Claim 17**, Gallagher discloses the magnetic memory device of claim 16 including the etching of the multilayer film.

44. Gallagher does not disclose where each of said etching of a remaining portion of said multi-layer film is carried out by using a physical and chemical etching

45. Yoshida teaches the etching of a multilayer film using reactive ion etching, which is both a physical and a chemical etching method. (column 7 lines 11-14)

46. It would have been obvious for one having ordinary skill in the art at the time the invention was made to using a physical and chemical etching method to etch the multilayer film as taught by Yoshida for the device of Gallagher, since reactive ion etching method offers the advantage that an object body can be subjected to anisotropic etching without destroying a thin insulation layer included in said object body. (column 7 lines 11-14)

47. Per **Claim 18**, in so far as definite, the claim is rejected over prior art as follows:

Gallagher discloses the magnetic memory device of claim 16 including the etching of the multilayer film.

48. Gallagher does not disclose where each of said etching of a remaining portion of said physical and chemical etching is a reactive ion etching.

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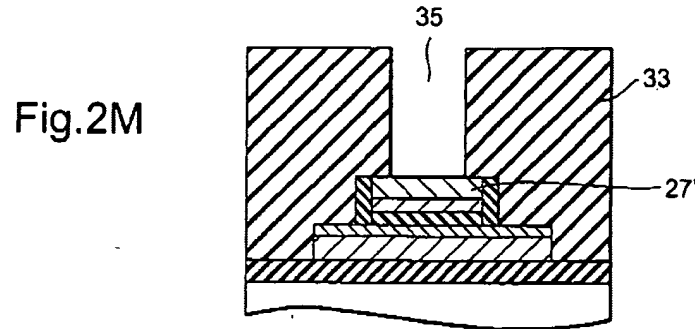
49. Yoshida teaches the etching of a multilayer film using reactive ion etching, which is both a physical and a chemical etching method. (column 7 lines 11-14)

50. It would have been obvious for one having ordinary skill in the art at the time the invention was made to using a physical and chemical etching method to etch the multilayer film as taught by Yoshida for the device of Gallagher, since reactive ion etching method offers the advantage that an object body can be subjected to anisotropic etching without destroying a thin insulation layer included in said object body. (column 7 lines 11-14)

51. **Claim 19-20** are rejected under 35 U.S.C. 103(a) as being unpatentable over Gallagher in view of Okazawa et al (European Patent No 1,248,305) hereinafter referred to as Okazawa.

52. Per **Claim 19**, Gallagher discloses the magnetic memory device of claim 12, however, Gallagher does not teach forming an interlayer insulating film to cover said lower portion structure of said magnetic element, said sidewall insulating film, and said upper portion structure of said magnetic element; and forming a via-hole in said interlayer insulating film so as to be connected with said upper portion structure of said magnetic element by an etching method, said sidewall insulating film is formed of a material which has an etching selection ratio smaller than said interlayer insulating film

53. Okazawa (figure 2M) teaches an MRAM device including an interlayer insulating film (33) that covers the upper and lower portion structures as well as the sidewall film; and with a via hole (35) in the interlayer insulating film so as to be connected with said upper portion structure formed by an etching method, and where the sidewall film is formed of a material which has an etching selection ratio smaller than said interlayer insulating film (column 11 lines 19-22)



Prior Art: Okazawa Figure 6B teaching an MRAM device.

54. It would have been obvious for one having ordinary skill in the art at the time the invention was made to include an interlayer insulating film to cover said lower portion structure of said magnetic element, said sidewall insulating film, and said upper portion structure of said magnetic element; and forming a via-hole in said interlayer insulating film so as to be connected with said upper portion structure of said magnetic element by an etching method, said sidewall insulating film is formed of a material which has an etching selection ratio smaller than said interlayer insulating film as taught by Okazawa for the device of Gallagher in order to make electrical contact with the device.

55. Per **Claim 20**, Gallagher discloses the magnetic memory device of claim 12, however, Gallagher does not teach forming an interlayer insulating film to cover said lower portion structure of said magnetic element, said sidewall insulating film, and said upper portion structure of said magnetic element; and flattening said interlayer insulating film on said upper portion structure of said magnetic element by a chemical mechanical polishing method or an etching-back method, said sidewall insulating film is formed of a material which has a selection ratio in the chemical mechanical polishing method or the etching-back method smaller than said interlayer insulating film

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56. Okazawa (figure 2M) teaches an MRAM device including an interlayer insulating film (33) that covers the upper and lower portion structures as well as the sidewall film; and where the sidewall film is formed of a material which has an etching selection ratio in the chemical mechanical polishing method or the etching-back method smaller than said interlayer insulating film (column 11 lines 19-22).

57. Okazawa does not teach the flattening said interlayer insulating film by a chemical mechanical polishing method or an etching-back method.

58. Tuttle teaches planarization of the top surface of an MRAM device by chemical mechanical polishing. (column 7 lines 51-55)

59. It would have been obvious for one having ordinary skill in the art at the time the invention was made to include an interlayer insulating film to cover the upper and lower portions structure of the magnetic element, as well as the sidewall insulating film, and to flatten the interlayer insulating film on said upper portion structure of said magnetic element by a chemical mechanical polishing method, where said sidewall insulating film is formed of a material which has a selection ratio in the chemical mechanical polishing method or the etching-back method smaller than said interlayer insulating film as taught by Okazawa and Tuttle for the device of Gallagher in order to make electrical contact with the device, and in order to reduce the device size. Planarization of the uppermost layers of the device was a well known technique at the time the invention was made.

Cited Prior Art

60. The following prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

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Reference 1: US Patent Application Publication No 2002/0074575 by Bangert et al. is cited as an example of a MRAM device.

Reference 2: US Patent Application Publication No 6,114,719 by Dill et al. is cited as an example of a MRAM device.

Reference 3: US Patent Application Publication No 6,178,112 by Bessho et al. is cited as an example of a MRAM device.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jami M. Valentine, Ph.D., whose telephone number is (571) 272-9786. The examiner can normally be reached on Mon-Thurs 8:30am-7pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Akm Ullah can be reached on (571) 272-2361. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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JMV 2/5/2007



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